University of California
Lawrence Livermore National Laboratory

Physics and Space Technology Directorate

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Livermore's work in physics and space technologies is crucial to national security and advances fundamental science

Mission

The Physics and Space Technology (PST) Directorate performs innovative research, develops new experimental tools, and demonstrates cutting-edge technologies in physics and space science. Our efforts are critical to the success of Livermore's programs that support national security as well as those that pursue fundamental science and technology.

Physics Research at Livermore

The PST Directorate plays key roles in all of Livermore's multidisciplinary programs. Science-based stockpile stewardship, in particular, presents some very challenging problems that require advances in fundamental scientific understanding. To this end, we utilize Livermore's unique experimental facilities, large-scale computer codes, and advanced supercomputers. We are collaborating in the Department of Energy's Accelerated Strategic Computing Initiative and are part of a multiprogram team designing the National Ignition Facility. In addition, we make significant contributions to Livermore's programs in nonproliferation, inertial confinement fusion, biology and biotechnology, energy, and the environment.

In the Livermore tradition of applying scientific expertise to solve real-world problems, we carry out research in various fields of physics, including:

- Materials physics.
- High-energy-density plasma physics.
- High-pressure physics.
- Nuclear and atomic physics.
- Computational physics.
- Space science and astrophysics.

Recent Accomplishments

- Design and demonstration of a novel sensor for nonintrusive remote identification of chemical emissions, a technology ideally suited for intelligence-gathering operations and the detection of chemical signatures indicative of covert nuclear weapons production.
- Application of Livermore's unique capabilities in plasma chemistry and pulsed-power technologies to investigate and disprove a Japanese claim of a new method for reducing nitrogen-oxide emissions from diesel engine exhaust, thus saving U.S. industry unnecessary R&D costs.
- Development of improved dose calculations for radiation treatment of cancer through the use of computer codes developed for nuclear weapons design.

Program Successes

Research conducted to address specific weapons-related issues has led to important scientific discoveries in all areas of physics and to major innovations in experimental techniques and diagnostic instrumentation. These advances have both enhanced our core weapons capabilities and opened exciting new areas of investigation.

Physics and nuclear technologies developed in Livermore's national-security work are being used in the B-Factory, a Department of Energy high-energy physics facility that is being designed and constructed by the Stanford Linear Accelerator Center and the Livermore and Berkeley laboratories. With help from Livermore, U.S. industry was awarded the largest B-Factory procurement contract, over competition from Japan's and Germany's largest firms.

In the MACHO (massive compact halo object) project, we used technologies developed by Livermore for the Department of Defense's strategic defense initiative, together with the telescope at an Australian astronomical observatory, to create a novel instrument for investigating the nature of dark matter (the missing mass) in our galaxy. The multidisciplinary team of researchers, led by Livermore, has used this instrument to make major scientific discoveries in astronomy. The U.S. Air Force and NASA are evaluating the capabilities demonstrated in this project for use in identifying potential Earth-threatening asteroids.

In the Clementine lunar mission, NASA's lunar scientists used sensor systems developed by Livermore on a spacecraft provided by the Naval Research Laboratory to completely map, for the first time ever, the surface of the moon. The information gathered by Clementine has led to major scientific discoveries regarding lunar evolution.

Contact

Richard J. Fortner, Associate Director, Physics and Space Technology;
Phone: (510) 423-9597; Fax: (510) 422-9523; E-mail: fortner1@llnl.gov

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